



# **S2 CERTDATA:** FACILITATE DEVELOPMENT AND MONITOR QUALITY OF INSPECTION ALGORITHMS

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CBP-ADEPT-05 Workshop  
July 26, 2023

# So What? Who Cares?

Space: Algorithm development and quality monitoring

## PROBLEM:

- The lack of historic inspection data is the most significant obstacle to developing algorithms for automated security inspection. How to safely share sensitive, labeled datasets?
- Data quality can significantly impact algorithm results. How do we prevent effects of hardware ageing and deliberate manipulation on adjudication?
- Algorithms will take over more inspection tasks, how do we detect drift in algorithm performance if nobody is watching?

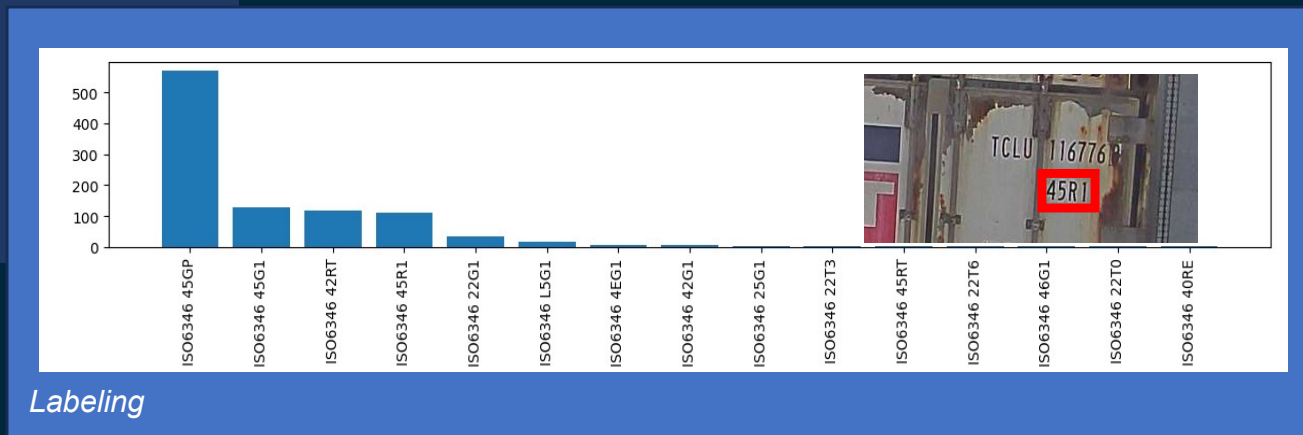
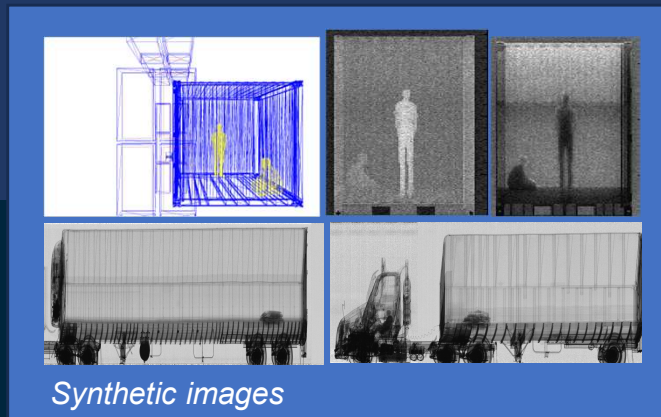
## SOLUTION: CERTDATA

- Data Service for sharing scan data with AI/ML developers. Data cleaned of PII and labeled based on own algorithms or shipping documentation.
- Intelligent Quality for Data with active monitoring of quality of data for all major imaging system OEM's.
- Intelligent Quality for Algorithms results with a benchmarking against S2 algorithms

# Data Service

- Hosting datasets for 3<sup>rd</sup> party ML algorithm development
  - Already host hundreds of thousands of scans available to developers
- Remote access through web browser
- Highest cybersecurity standards
- Labeling and annotation
- Synthetic images

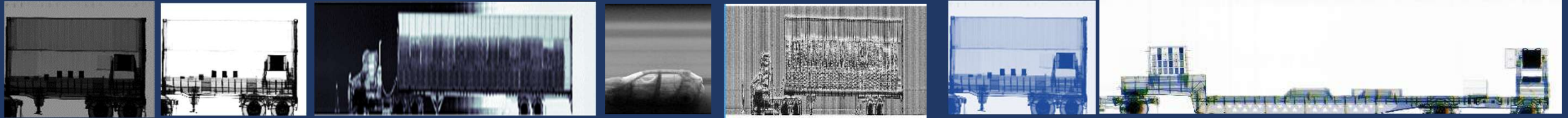
Data Service Tool for developers



# Intelligent Quality (IQ) for Data

## *Examples of data quality problems*

### Normalization/calibration problems

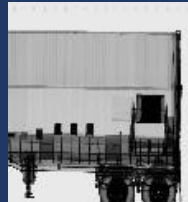


### Scan execution

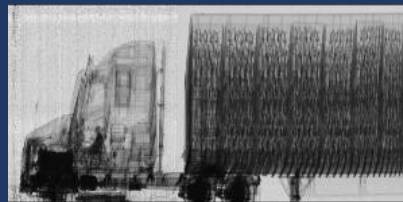
Scan started too early;  
driver irradiated



Scan started too late;  
container cut off



Scan stopped too early;  
container cut off



Scan speed too slow



Scan speed too fast



Scan too long



Image with 2  
containers



Image without  
object

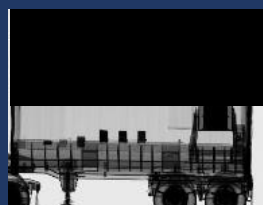


### Detector array problems

Bad detectors



Failed readout



Large noise



### X-ray source problems

Missing linac  
pulses



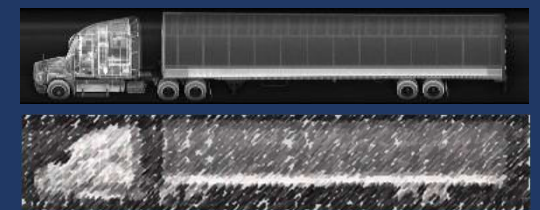
Penetration  
problems



### Interference with other systems



### Data conversion

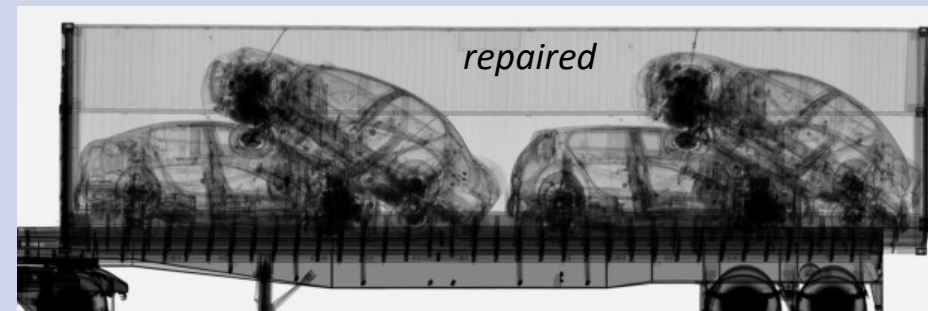
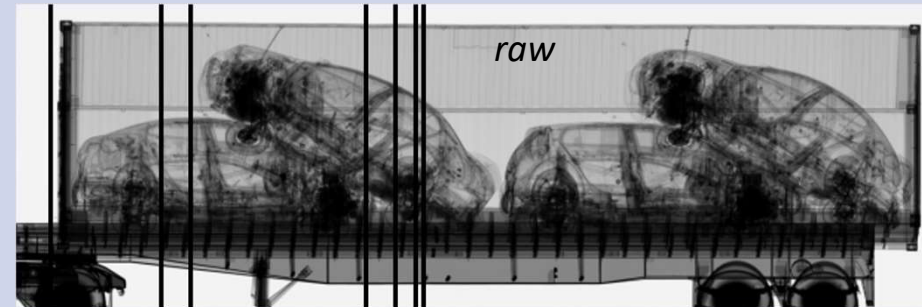
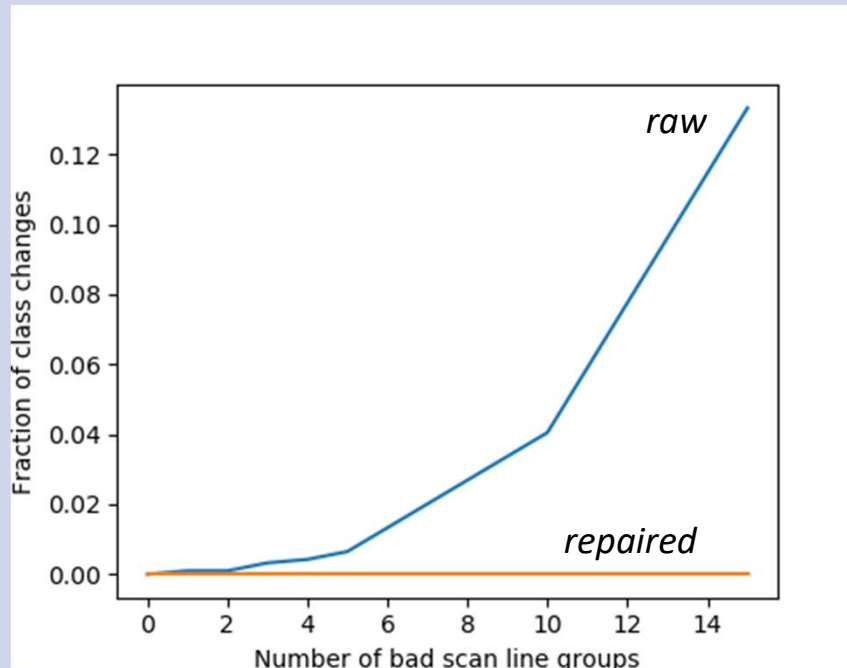


Active monitoring for data quality problems for all major OEM's

# Intelligent Quality for Data

## *Data quality impact on classification*

### Bad scan lines



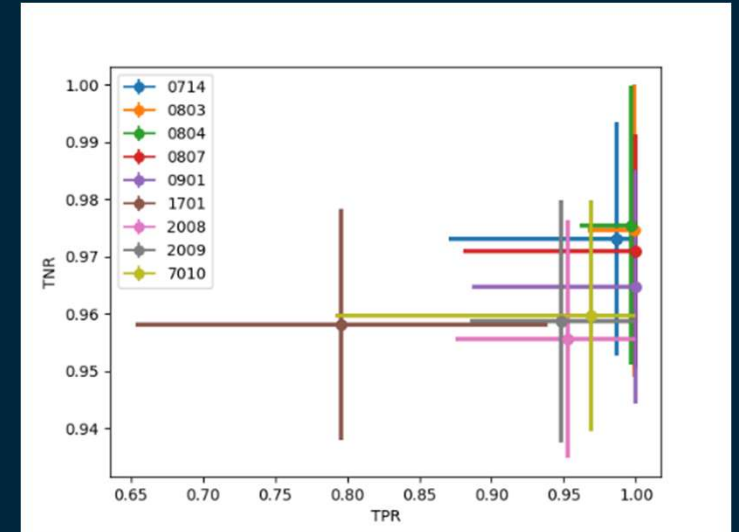
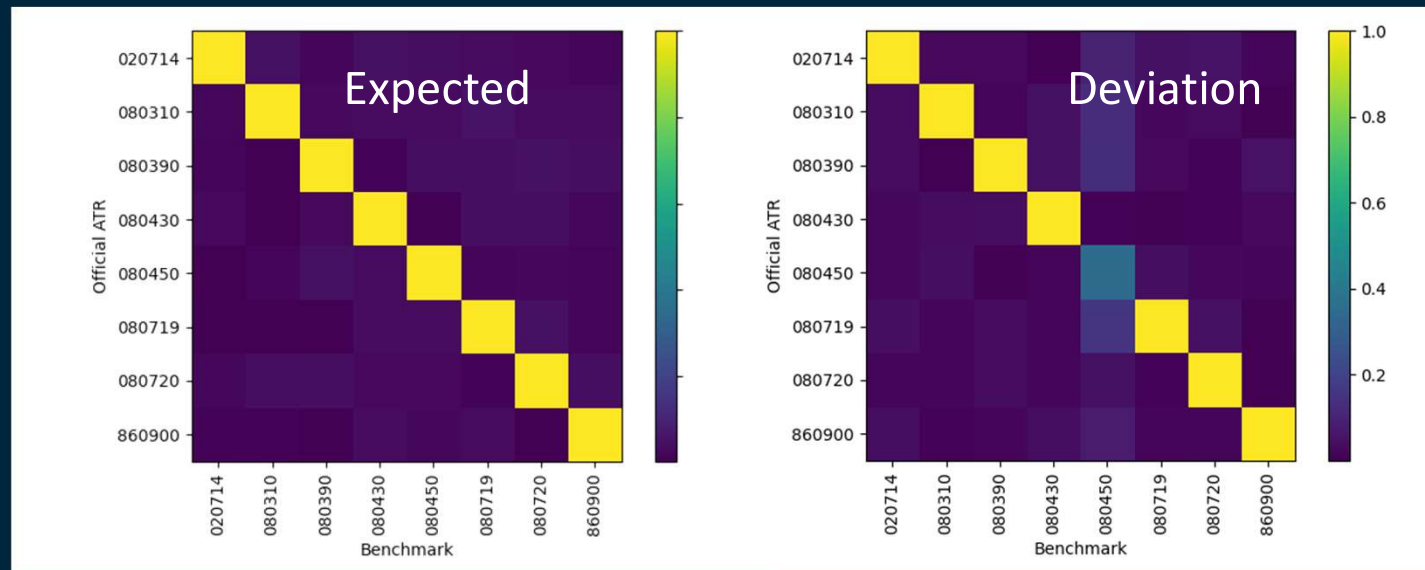
- Robustness testing of your algorithms against a set of expected problems due to imaging hardware ageing or possible deliberate attacks.
- Recommended for every algorithm prior to deployment.

# Intelligent Quality for Algorithms

## Algorithm Benchmarking

Implementations of algorithm quality monitoring:

- Evaluation on a fixed dataset or dynamically labeled dataset
- Evaluation against other algorithms on live data

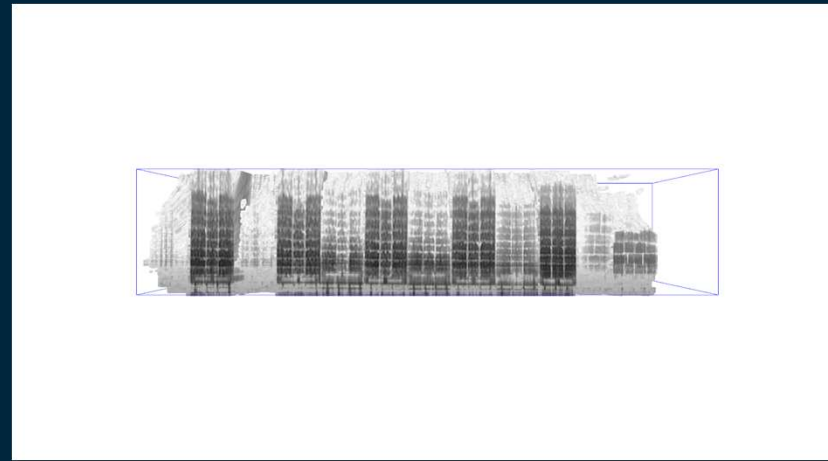


- Correlated data (e.g., image v. image)
- Uncorrelated data (e.g., image v. manifest)

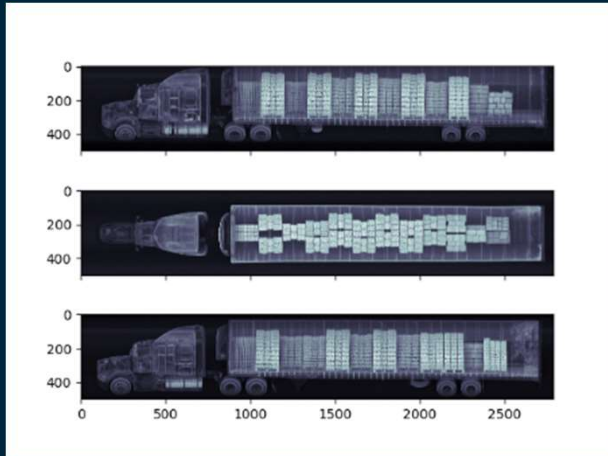
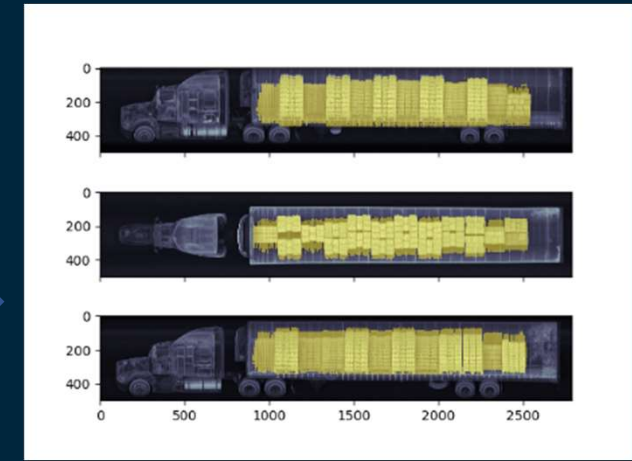
*Continuous monitoring of algorithms to detect degradation in performance*

# An example of benchmarking algorithm: Empty container verification in multi-view systems

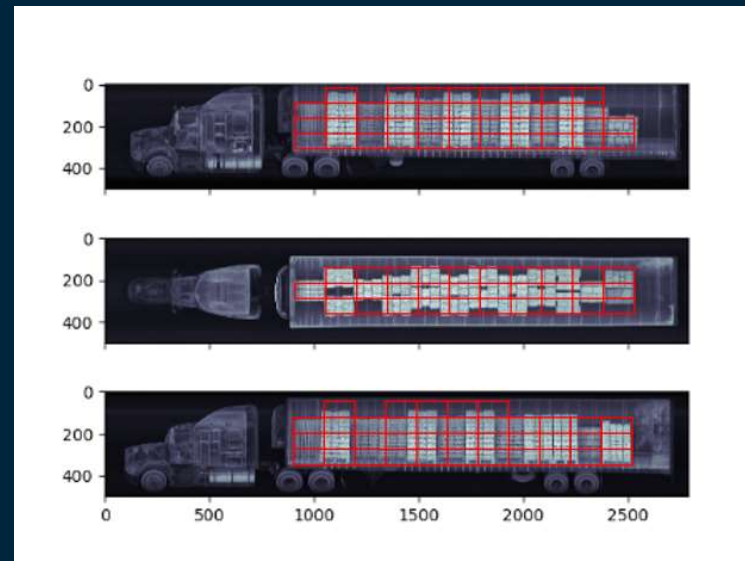
IQ: 3D reco  
(analytical  
model)



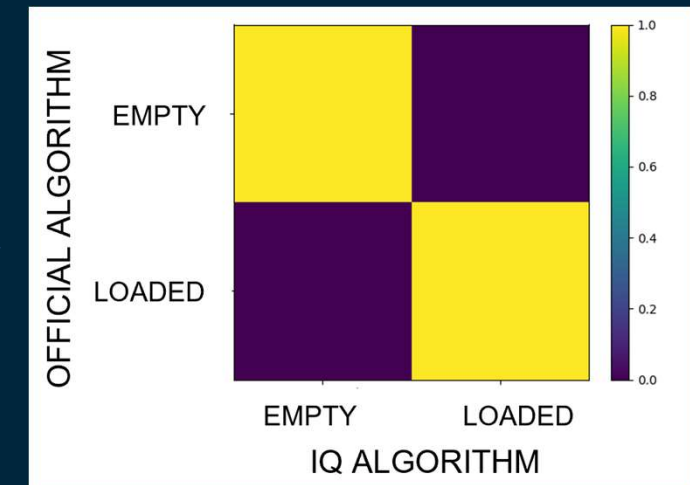
2D  
projection



Official:  
3 x ML (2D)  
model



Benchmarking



## Data Service for Algorithm Development

Share datasets with  
algorithm developers.

Create large labeled  
datasets including  
synthetic images.

## Intelligent Quality: Data

Monitor suitability of  
data for operator or  
algorithm analysis.

Study impact of known  
hardware failures on  
algorithm results.

## Intelligent Quality: Algorithms

Benchmark algorithm  
performance against  
S2 version of the  
algorithm or test  
samples.

## Questions and Contact:

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